

**TRANSFER OPERATION-I
(BTC2201)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The fluid, in which the shearing stress within it, is proportional to the velocity gradient across the sheared section, is called a _____ fluid
 - (a) Newtonian
 - (b) perfect
 - (c) Bingham
 - (d) none of these
- (ii) What is an ideal fluid?
 - (a) fluid which has no viscosity
 - (b) fluid which has no surface tension
 - (c) fluid which is incompressible
 - (d) All the above
- (iii) NPSH in centrifugal pump is defined as
 - (a) the sum of the velocity head and the pressure head at discharge
 - (b) suction minus vapor pressure of the liquid at suction temperature
 - (c) sum of the velocity head and the pressure head at discharge
 - (d) discharge minus vapor pressure of the liquid at the discharge temperature
- (iv) Venturimeter is based upon the principle of
 - (a) Euler equation
 - (b) Navier-Stokes equation
 - (c) Bernoulli's equation
 - (d) none of these
- (v) The main function of centrifugal pumps are to
 - (a) Transfer speed
 - (b) Transfer pressure
 - (c) Transfer temperature
 - (d) Transfer energy
- (vi) Counter flow heat exchanger is preferred for
 - (a) rapid initial cooling
 - (b) uniform cooling
 - (c) gradual cooling
 - (d) None of the above
- (vii) Unit of overall heat transfer coefficient is
 - (a) m².K/W
 - (b) W/m.K
 - (c) W/m².K
 - (d) m.K/W

- (viii) Prandtl Number is equal to
 (a) $C_P \mu / k$ (b) $D \nu \rho / \mu$ (c) $h_i D / k$ (d) None of the above
- (ix) Which of the following crushing laws is most accurately applicable to the grinding of stones?
 (a) Bond's Law (b) Rittinger's Law (c) Kick's law (d) All the above
- (x) Filtration at constant pressure is given by
 (a) Fourier's law (b) Fick's law (c) Ruth's equation (d) Reynold's equation

Fill in the blanks with the correct word

- (xi) Formula of LMTD is _____
- (xii) Value of Stefan Boltzmann's constant is _____
- (xiii) The fluid coming into the centrifugal pump is accelerated by _____
- (xiv) Unit of kinematic viscosity of a fluid _____
- (xv) Friction factor is defined as _____

Group - B

2. (a) Derive Bernoulli's equation for fluid flowing through a smooth pipe. [[CO3](Derive/IOCQ)]
- (b) A patient who is recovering from surgery is being given fluid intravenously. The fluid has a density of 1120 kg/m^3 . If $9.8 \times 10^{-4} \text{ m}^3$ of fluid flows into the patient in every four hours, find the mass flow rate in kg/hr. [[CO3](Compute/IOCQ)]
8 + 4 = 12
3. (a) Describe the phenomenon of boundary layer separation. [[CO2](Analyse/IOCQ)]
- (b) Describe the flow behaviour of fluid flowing under laminar condition and turbulent condition? [[CO1](Remember/LOCQ)]
- (c) What is Reynolds number. State its significance in flow behaviour of fluid. [[CO2](Understand/LOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) What is NPSH? How NPSH is calculated for (i) suction head system and (ii) suction lift system. [[CO3](Analyse/HOCQ)]
- (b) Explain the working principle of Rotameter. [[CO3](Remember/LOCQ)]
(2 + 2 + 2) + 6 = 12
5. (a) An orificemeter of pipe diameter 150 mm with orifice dia 75 mm size is used to measure the flow rate of oil having specific gravity of 0.9. The reading shown by the U tube manometer connected to the venturimeter is 150 mm of mercury column. Calculate the coefficient of discharge for the orificemeter if the flow rate is $1.7 \text{ m}^3/\text{min}$. [[CO3](Apply/HOCQ)]

(b) What is cavitation and how this can be avoided?

[[C04](Remember/LOCQ)]

6 + 6 = 12

Group - D

6. (a) Derive an expression for heat transfer through a hollow cylinder.

[[C04](Remember/LOCQ)]

(b) A small oxidized horizontal metal tube with an OD of 0.0254m and being 0.61m long with a surface temperature at 588K is in a very large furnace enclosure with fire-brick walls and the surrounding air at 1088K. The emissivity of the metal tube is 0.6 and 0.46 at 588K. Calculate the heat transfer to the tube by radiation.

[[C05](Calculate/IOCQ)]

6 + 6 = 12

7. (a) Derive a mathematical model for heat transfer through a compound wall made of three different layers.

[[C04](Remember/LOCQ)]

(b) Oil is flowing through a 75mm OD iron pipe at 1.5m/s. It is being heated by steam outside the pipe and the steam film coefficient is 11,000W/(m².°C). At the particular point along the pipe, the oil is at 50°C, its density is 880kg/m³, viscosity is 2.1 cP, thermal conductivity, k, is 0.135W/(m.°C), specific heat, Cp,=217J/(g°C). What is the value of U_o, based on the outside area of the pipe? Given: $(h/(C_p \cdot v \cdot \rho)(Pr)^{2/3} = 0.023(Re)^{-0.2}$.

[[C04](Calculate/HOCQ)]

6 + 6 = 12

Group - E

8. (a) What is the power required to crush 100tons/h of limestone if 80% of the feed passes a 2in screen and 80% of the product a 1/8 in screen? Work index of limestone is 12.74.

[[C05](Calculate/IOCQ)]

(b) State Bond's Law.

[[C05](Remember/LOCQ)]

(c) Derive Ruth's equation.

[[C05](Remember/LOCQ)]

6 + 2 + 4 = 12

9. Data for the laboratory filtration of CaCO₃ slurry in water at 298K are reported as follows at a constant pressure drop of 338KN/m². The filter area of the plate and frame press was A= 0.0439m² and the slurry concentration was C_s = 23.47kg/m³. Calculate the constants α and r_m from the experimental data given, where t is time in s and V is filtrate volume collected in m³. (Given: viscosity of water at 298K is 8.937x10⁻⁴ kg/m.s.)

Vx10 ³ (m ³)	0.5	1	1.5	2	2.5	3
t (s)	17.3	41.3	72	108.3	152	201.7

[[C06](Calculate/HOCQ)]

12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	39.5	29.2	31.3

